# EXPLORATION ON TRAFFIC CHARACTERISTICS AND GAP ASSESSMENT ON MIDBLOCK U-TURN FACILITIES

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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Civil Engineering.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRACT

The idea of a Midblock U-turn Opening installation is to eliminate direct right turns. Midblock U-turning facilities are median openings on multi-lane highways. U-turning facilities aimed at easing traffic conflicts and pressures at highway intersections. This study is to identify the influence of midblock U-turn facilities towards traffic parameters of speed, flow and density relationship and to determine the safe merging gap for the midblock U-turn facilities. This study is referring to unsignalized junction, that is the midblock U-turn facilities located at Jalan Tanah Putih, heading to Kuantan, Pahang. The traffic characteristics of this study is to define the speed, flow and density when the vehicle at free flow speed and when reaching the conflict point near the midblock U-turn facilities. Raff's Method is the method used to analysed the critical gap for the passenger car that want to make a U-turn. By using Raff Method, the gap acceptance and gap rejected will be observe and from these data, it can produce a linear graph which can determined the critical gap. The result obtained showed the traffic characteristics relationship which is speed, flow and density that the data relationship was similar to Greenshield Model and critical gap of the U-turn was 5.0 second. The critical gap was comply with the standard of Malaysia Public Work Department and Transportation Research Board. The result show from the speed, flow and density relationship, the road was in a good condition and the drivers behavior that desire to merge into major road from the U-turn.

# ABSTRAK

Idea pemasangan persimpangan pusingan U adalah untuk menghapuskan pergerakan ke arah kanan yang tidak terurut. Kemudahan persimpangan pusingan U adalah memberi ruang bukaan di jalan raya yang mempunyai berbilang lorong bagi menukar arah laluan dan bertujuan untuk mengurangkan konflik lalu lintas di persimpangan jalan raya. Kajian ini adalah untuk mengenal pasti pengaruh persimpangan U terhadap parameter lalu lintas berhubung dengan kelajuan, aliran dan ketumpatan dan untuk menentukan jurang penggabungan yang selamat di fasiliti persimpangan U. Kajian ini merujuk kepada persimpangan U yang terletak di Jalan Tanah Putih, menuju ke Kuantan, Pahang. Ciri-ciri lalu lintas kajian ini adalah untuk menentukan kelajuan, aliran dan kepadatan ketika kenderaan pada kecepatan aliran bebas dan ketika mencapai titik konflik berdekatan fasiliti persimpangan U. Kaedah Raff adalah kaedah yang digunakan untuk menganalisis jurang kritikal bagi pemamdu kereta yang ingin membuat pusingan U. Dengan menggunakan kaedah Raff, jurang yang diterima dan jurang yang ditolak akan diperhatikan dan dari data ini, ia boleh menghasilkan graf yang boleh menentukan jurang kritikal. Hasil yang diperoleh menunjukkan hubungan ciri-ciri lalu lintas yang merupakan kelajuan, aliran dan ketumpatan bahawa hubungan data tersebut serupa dengan model Greenshield dan jurang kritikal bagi pusingan U tersebut ialah 5.0 saat. Jurang kritikal adalah mematuhi piawaian Jabatan Kerja Raya Malaysia dan Lembaga Penyelidikan Pengangkutan Awam. Hasil kajian menunjukkan bahawa hubungan kelajuan, aliran dan ketumpatan jalan berada dalam keadaan yang baik dan tingkah laku pemandu yang ingin bergabung ke jalan utama dari giliran U.

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| | |
|---|---|
| q | Flow (veh/h) |
| k | Density (veh/km) |
| v | Speed (km/h) |
| t | perception / reaction time, sec, typically 2.5 sec |
| f | coefficient friction |
| g | percent grade (% / 100) |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| SSD | Stopping Sight Distance |
| PWD | Public Work Department |
| FFS | Free Flow Speed |
| BFFS | Base Free Flow Speed |
| AASHTO | American Association of State Highway Transportation Organization |

# CHAPTER 1

# INTRODUCTION

## 1.0 Background

Heavy traffic volumes at signalizad at-grade intersections on urban and suburban multilane divided highways may cause the traffic signal control system installed failed to function efficiently which in turn may lead to congestions and excessive traffic delays. According to Liu Pan (2008), the idea of a U-turn facility installation is to eliminate direct right turns. There are many problems are appeared at the intersection such as congestion, queues, delay and also accident. Brilon (1999) said that the evaluation of capacity at unsignalized intersection is practically measured using the gap acceptance approach and used for unsignalized intersection procedure. In this study, the gap acceptance approach was used for unsignalized intersection procedure. The critical gap is a major parameters need to be considered to analysis the unsignalized intersection. In Malaysia, the critical gap for an unsignalized intersection is proposed by Highway Capacity Manual (2011). Therefore, the critical gap is difference between each intersection based on the geometry of the road, numbers of lane, and surrounding area located near the intersection. According to Ban (2009) the efficiency of the performance at unsignalized intersection is become worst if the problem such as delay, queue is always occurred. Therefore, this research should be evaluated by taking the data traffic volume and relate with time which is during peak hour. In addition, this research also important to assess the road situation which shows the maximum level of usage.

## 1.2 Problem Statement

The idea of a Midblock U-turn Opening installation is to eliminate direct right turns. Traffic operation at a midblock U-turn opening is illustrated in Figure 1.1. Considering a U-turning vehicle A in figure 1, arrived at the U-turn opening from major

road of opposite direction, will enter the accerleration lane and reach merging arrival point. At this point, the vehicle will move slowly while searching for suitable gaps until it departs at the merging departure point. The departure point varies for each vehicle. During the merging activities, vehicle in acceleration lane will have conflict points with the vehicles from near-side and far-side of major road. A particular concern about a midblock U-turn is that it may result in safety and operational problems. A precise analysis or design of U-turn is a very important task because undesirable incident at any U-turn opening can affect the operational of traffic on the entire highway. This study is to analyse the result carried out to evaluate speed, flow and density relationship, driver critical gap for merging maneuvers at midblock U-turn opening. To date, limited reported studies that address such a facility were only focused on the merging gap acceptance behaviour.

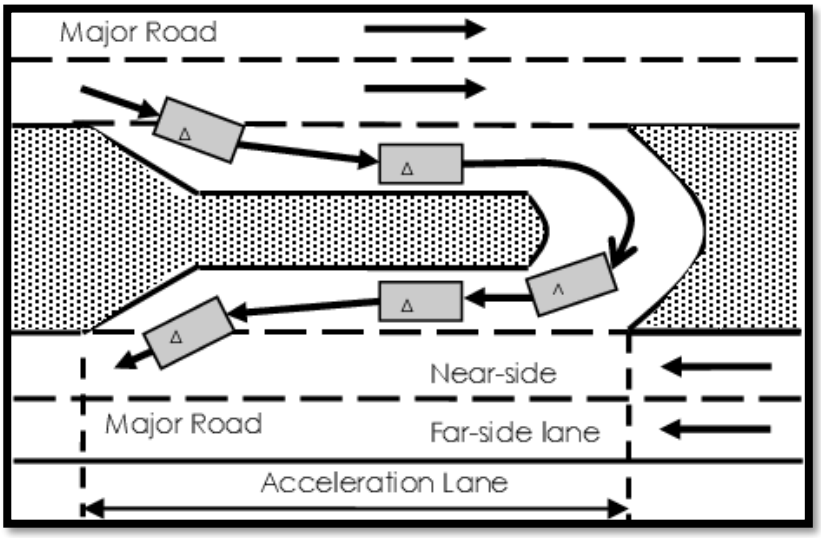


**Figure 1.1:** Illustration of merging at midblock U-turn opening

## 1.3 Research Objective

The aim and objective of this case study is to analyse the effectiveness of Midblock U-turn Opening movement along Jalan Tanah Putih. To achieve the aim of this study, the following objectives have been set as:

i. to identify the influence of midblock U-turn facilities towards traffic parameters of speed, flow and density relationship
ii. to determine the safe merging gap for the midblock U-turn facilities

## 1.4 Scope of work

The scope of this research is to focus on the effectiveness of speed, flow and density relationship, and critical gap for U-turn movement at Jalan Tanah Putih. The authorities involved in this study are Public Work Department (JKR).

This study focuses on the free flow speed of vehicle that desire to travel on the major stream and wants to do U-turning at the midblock U-turn opening and to analyse the critical gap at U-turn area to merge major stream. The time to collect data is on weekdays during peak hours from 7.00am until 11.00am. The data will collected three days in a week (tuesday, wednesday and thursday).

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